



Original Communication

Abdominal X-ray signs of intra-intestinal drug smuggling

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ABSTRACT

**Introduction:** "Body packers" either swallow or insert drug filled packets rectally or vaginally in order to smuggle illicit drugs. AXR is used routinely to screen suspects for the presence of intra-intestinal drug packages. AXR diagnosis can be difficult as stool or gas within the intestine may resemble ingested foreign bodies. We identify the frequency and co-existence of several signs; tic-tac sign, rosette sign, double condom sign, dense surrounding material, density and discover a new sign; parallelism, which will aid in increasing the radiological accuracy.

**Methods:** We retrospectively reviewed 285 AXRs performed for suspicion of drug smuggling during the period of March 2006–March 2009 to identify the frequency of these signs.

**Results:** Of the 285 AXRs performed 59 were positive, 221 negative and five were indeterminate. The tic-tac sign was present in 93%, double condom sign in 73%, dense surrounding wrapping material in 36% and parallelism in 27%. Sixty one percentage of drug packages were iso-dense to faeces and 39% hyperdense. Twenty percentage of the positive abdominal radiographs demonstrated one of the radiographic signs, 39% demonstrated two signs, 32% demonstrated three and 7% four. The most common radiographic sign combination was the tic-tac sign with either dense surrounding material or double condom sign.

**Conclusion:** The most commonly encountered radiographic sign is the tic-tac sign, followed by the double condom sign and dense surrounding material. We also discover a new sign, "parallelism" which although uncommon is highly specific. Accuracy is further increased by comparing the density of packages to faeces and looking for the co-existence of multiple signs.

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## 1. Introduction

Heathrow Airport is located in the London Borough of Hillingdon and is the largest and busiest airport in the United Kingdom (UK). It is the world's third busiest airport for passenger traffic after Atlanta's Hartsfield-Jackson and Chicago's O'Hare, with a total annual through put of 67 million passengers. Heathrow Airport is used by over 90 airlines that fly to 170 destinations worldwide.

As one of the world's busiest international airports, Heathrow is a major point of entry of illicit drugs into the United Kingdom. One form of illicit drug smuggling is by "body packing". This involves smuggling multiple packets containing drugs by either swallowing or inserting the packets rectally<sup>1–3</sup> or vaginally.<sup>3</sup> Her Majesty Revenue Customs (HMRC) inspectors are specially trained to recognise

potential body packers. The Custody Suite at Heathrow Airport processes potential body packers from anywhere in the south of England, receiving suspect passengers from all of the UK southern airports, as well as the southern sea ports and from London's St. Pancras Train Station, where body packers attempt to gain entry to the UK via the Eurostar tunnel.

Many suspects admit to swallowing packets without the need for further investigation, especially when faced with the prospect of detention until a bowel motion is passed in secure facilities. In those who do not readily confess, other tests are used to establish diagnosis, the most common being urine analysis. When there is further uncertainty (which is only in a small proportion of suspects) a plain abdominal radiograph (AXR) is requested to detect any concealed packages in the lumen of the gastrointestinal tract and may be considered the diagnostic gold standard in routine practice. An AXR may also be requested to determine if the individual is 'clear', as there may be a discrepancy between the number of packages that have been swallowed to that which have been passed rectally. Hillingdon Hospital, which is the neighbouring hospital to Heathrow airport, provides supports to the HMRC offi-

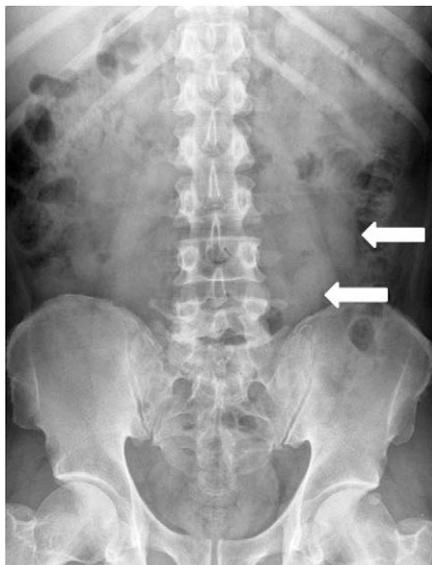
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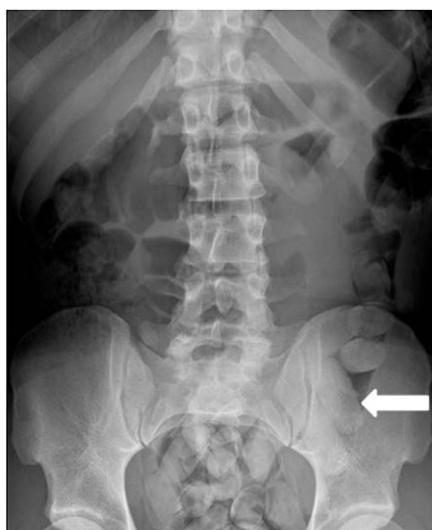
cers by performing AXRs on consenting suspect passengers, and has probably the largest series of AXRs in the UK.

Although several large series studies<sup>1,4,5,8</sup> suggest that plain abdominal radiography has a sensitivity of 85–90%, diagnosis from a plain abdominal radiograph can often be difficult for the untrained radiologist, as stool or gas within the intestine may resemble ingested foreign bodies (Fig. 1). Insipidated faeces has been shown to give rise to false positive radiographs.<sup>6</sup> Correct identification is therefore dependent on many factors namely size, form, number and position of the packets.

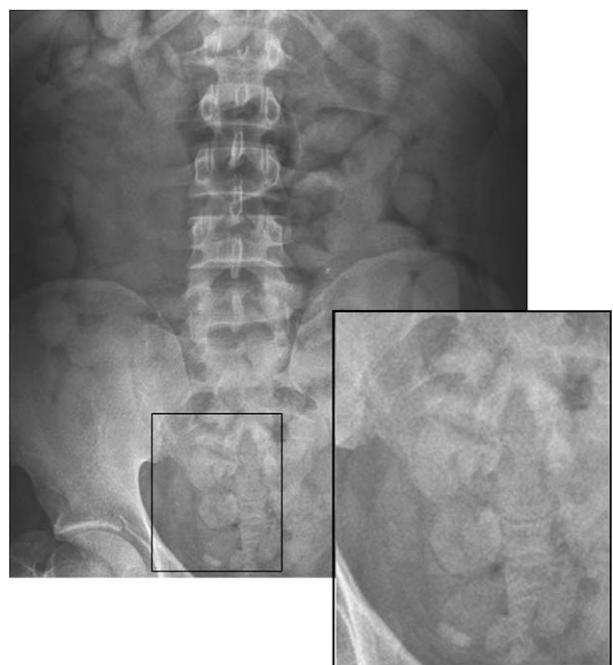
The characteristic radiographic signs that should be considered when looking for intra-luminal packages are multiple oblong, uniformly shaped packages, which we have termed the “tic-tac sign” (Fig. 2); the “rosette sign”<sup>4,7</sup>, which is formed by air trapped in the knot where the condom is tied, and the “double condom sign” (Figs. 3 and 4)<sup>8</sup> which is a lucent rim of air trapped between multi-



**Fig. 1.** Ingested drug packages are of a similar density to faeces and can be difficult to identify.



**Fig. 2.** Abdominal radiograph showing multiple oblong, uniformly shaped intra-intestinal drug packages, which we have termed the “tic-tac sign”.



**Fig. 3.** Abdominal radiograph showing the double condom sign.



**Fig. 4.** Abdominal radiograph showing multiple drug filled packages some of which exhibit the double condom sign.

ple layers of latex, which may be less evident with well machine wrapped packages.

Furthermore, the density of the ingested packet is variable and is determined by the type of wrapping material used, ranging from densely radio-opaque aluminium (Fig. 6), which is rarely employed these days, to radiolucent wax and the packet contents. The density of the drug products also varies. The density of cocaine is more like faeces or water, heroin tends to be less dense than faeces, whereas cannabis more dense than faeces.<sup>9</sup> The number of drug filled packets may also vary considerably from a single packet to up to 200 packets.<sup>10</sup> Another sign, which as yet has not been reported but may aid diagnosis, is “parallelism” (Fig. 5), where the relatively rigid packages align parallel to each other in the bowel lumen.

From our experience we assess the frequency at which the above signs are encountered and identify new signs, which may aid diagnosis.

## 2. Methods

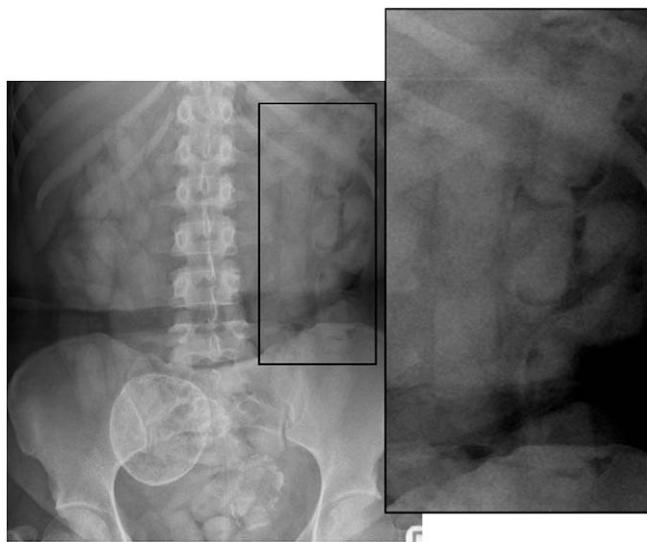
A retrospective study was performed looking at all the plain abdominal radiographs of individuals suspected of drug smuggling that were referred to Hillingdon Hospital by HMRC authorities during the period March 2006–March 2009. The data was obtained from our department's radiology information system (CRIS) and the plain abdominal radiographs were retrieved and viewed on a picture archiving and communication system (PACS). All individuals consented in writing to the AXR examination. AXR in pregnant female suspects or women of childbearing age in whom there was uncertainty about pregnancy status was contraindicated, and they were sent directly for stool assessment without radiography.

AXRs were taken with the subjects in the supine position with automated exposure control. The AXRs were immediately read by the duty radiologist and then reviewed by an independent radiologist at a separate sitting. Each radiograph was recorded as pos-

tive, negative or indeterminate for intra-intestinal drug packages. Of the positive radiographs the approximate number of packages and the presence of the following signs – the density of the surrounding material, the tic-tac sign, the double condom sign, the rosette sign, parallelism and the density of the contents relative to faeces were recorded.

## 3. Results

During the period March 2006–March 2009, 285 individuals had plain abdominal radiographs at Hillingdon Hospital for suspected drug smuggling. Out of the 285 AXRs taken 59 were positive, 221 negative and five were indeterminate. Fifty patients had swallowed multiple packets ranging from 5 to 200. Table 1 and Fig. 7 shows the percentage of radiographs positive for each radiographic sign with the tic-tac sign being the most frequent, present in 93% of cases, followed by the double condom sign, present in 73% of cases. Dense surrounding wrapping material and parallelism were less frequently encountered, present in 36% and 27% respectfully. The rosette sign was not demonstrated in our series. The majority of drug packages were iso-dense to faeces (61%) (Table 2, Fig. 8) with 39% presenting as hyperdense structures and none presenting as hypodense structures. Twenty of the positive plain abdominal radiographs demonstrated one of the radiographic signs, 39% demonstrated two of the radiographic signs, 32% demonstrated three and 7% four (Table 3, Fig. 9). In only 2% (one



**Fig. 5.** Abdominal radiograph showing how drug filled packages lie in parallel in the bowel lumen termed "parallelism".

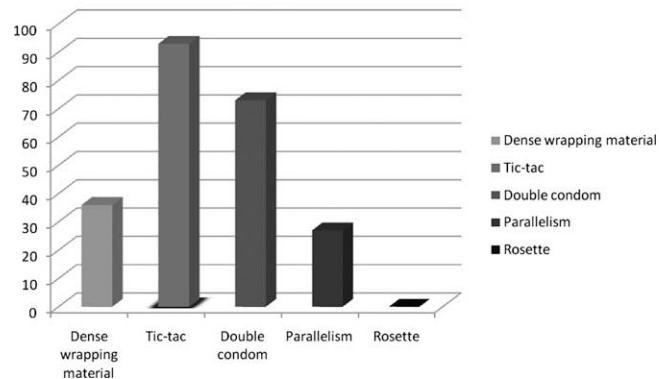


**Fig. 6.** Abdominal radiograph showing multiple intra-intestinal drug filled packets with dense surrounding material.

**Table 1**  
Percentage of radiographs positive for each radiographic sign.

Radiographic sign	Percentage positive (%)
Dense wrapping material	36 (n = 21/59)
Tic-tac	93 (n = 55/59)
Double condom	73 (n = 43/59)
Parallelism	27 (n = 16/59)
Rosette	0 (n = 0/59)

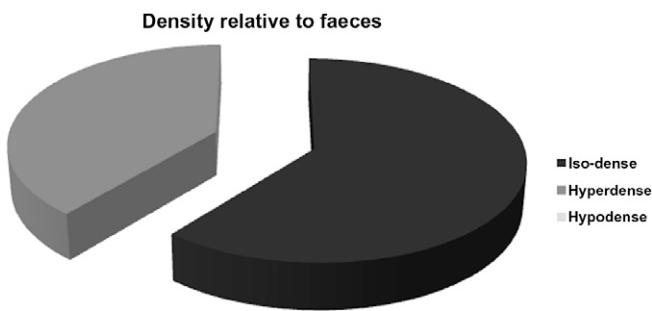
**Percentage of AXR's positive for each radiographic sign**



**Fig. 7.** Bar chart demonstrating the number and the percentage of the radiographic sign's encountered.

**Table 2**  
Density of the intra-intestinal drug packages relative to faeces.

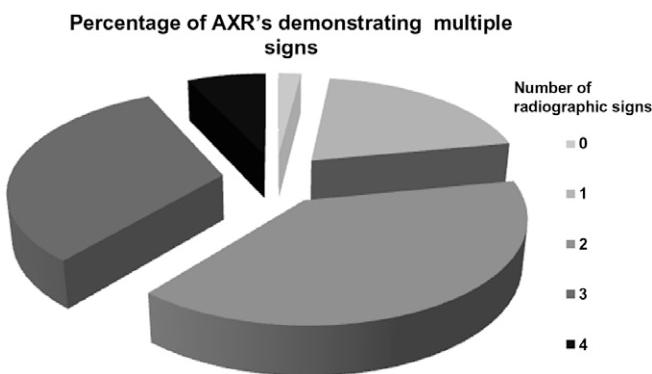
Density relative to faeces	Percentage (%)
Iso-dense	61 (n = 36/59)
Hyperdense	39 (n = 23/59)
Hypodense	0 (n = 0/59)



**Fig. 8.** Pie chart depicting the proportion of suspect intra-luminal packages relative to their density to faeces.

**Table 3**  
Percentage of radiographs positive for one or more radiographic signs.

Number of signs	Percentage (%)
0	2 (n = 1/59)
1	20 (n = 12/59)
2	39 (n = 23/59)
3	32 (n = 19/59)
4	7 (n = 4/59)



**Fig. 9.** Pie chart demonstrating the proportion of AXR's of suspect intra-luminal packages demonstrating multiple radiological signs.

radiograph out of the 59) none of the radiographic signs mentioned were present. The most common radiographic sign combination was the tic-tac sign with either the dense surrounding material or the double condom sign.

#### 4. Discussion

Body packing is a recognised form of drug smuggling and suspected individuals are often brought to hospital emergency departments by HMRC officers for diagnosis. Since plain abdominal radiography is the imaging diagnostic gold standard in routine practice, radiologists need to know how to interpret the plain abdominal radiograph and be aware of the signs that may aid in the correct diagnosis.

Many plain abdominal radiographs present no difficulty in interpretation. Typically drug materials appear as multiple uniformly dense foreign bodies of similar density to faeces, the wrapping materials can be of higher density enabling more accurate visualisation. However, in over 60% of cases, the wrapping material cannot be easily seen and relying on the density alone may lead to false positive and false negative results. In such situations several other signs are helpful in interpretation. In our series we show that the multiple uniform oblong-shaped opacities, termed the tic-tac sign is extremely common being present in the majority (93%) of cases. The previously reported double condom sign is also a com-

mon feature, present in 73% of cases. In our series we have shown that the rosette sign is no longer a useful characteristic, which may be accounted for by changes in the way the drugs are wrapped, i.e. machine wrapping. Finally we discover a new sign which we have termed "parallelism", which although is not as common (27% of cases), is highly specific when present. The sensitivity of package identification and correct diagnosis can be further increased by looking out for the presence of multiple signs, in particular the presence of the tic-tac sign together with either the double condom sign or hyperdense surrounding material.

Other modalities may also play an important role when a strong suspicion of body packing exists but the plain radiograph is negative. Ultrasonography is appealing as a screening modality as it is safe, but there is little data to support its use. One small study indicates that drug filled packages are easily identified as hyper-echoic structures that exhibit posterior acoustic shadowing.<sup>5</sup> However, faecal matter may have the same ultrasound characteristics, and the ultrasound beams cannot penetrate bowel gas, leading to a high rate of false positive and false negative scans. The use of computed tomography (CT) as an imaging modality is also not yet known.<sup>11</sup> Although it involves significantly greater radiation exposure, CT may demonstrate foreign packages within the bowel not easily identified on X-ray or ultrasound.<sup>12</sup> However, one study reported a false negative.<sup>13</sup> CT is also useful for the identification of any associated complications, such as intestinal obstruction or perforation, but is not appropriate as a screening tool due to the excessive ionising radiation burden. Another alternative method is contrast-enhanced abdominal radiography with water-soluble contrast agents, which may identify drug packets as filling defects within the contrast medium. In one series plain contrast radiography identified all body packers, although in one patient a single packet was missed.<sup>1</sup> This method is however more intrusive as large quantities (up to a litre) of contrast agent needs to be ingested and a further 20–120 min has to elapse before the contrast agent passes into and outlines the small and large bowel. The contrast agent may also mask smaller packets and may cause an intra-luminal diuresis which may lead to intestinal obstruction. Magnetic resonance imaging (MRI) has not been reported for the detection of intra-luminal suspect packages. However, it is not an appropriate modality for this indication, and would involve difficult technical and patient consent issues. When performed for clinical indications, a small bowel MRI study involves ingesting a large amount of oral contrast, an injection of buscopan (hyoscine butylbromide) to paralyse the bowel and 20–30 min scanning time in a supermagnet. MRI is usually in limited supply, especially out of hours, when most of these cases present to the radiology department.

In the United Kingdom if the plain abdominal radiograph is negative but clinical suspicion remains high, the suspect is kept in custody until the suspect packages are passed rectally, rather than resorting to the other imaging modalities mentioned above.

Although plain abdominal radiography is the radiological gold standard screening tool for intra-intestinal drug packages, it is not 100% sensitive and will occasionally miss small or less numerous packages. We were not able to obtain accurate follow-up information from HMRC, and therefore are unable to give quantitative figures for sensitivity and specificity for our series. However, we have nevertheless identified the frequency and co-existence of several signs and discovered a new sign (parallelism), which will aid in further increasing the radiological accuracy of this simple test.

#### 5. Conflicts of Interest

I, Sylwia Niewiarowski, declare that I have no proprietary, financial or other personal interest of any nature or kind in any product, service and/or company that could be construed as influencing the

position presented in, or the review of the manuscript entitled, "Abdominal X-Ray signs of intra-intestinal drug smuggling".

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## Ethical Approval

None declared.

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